Re-narration as a basis for accessibility and inclusion on the World Wide Web

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ABSTRACT

"Designing for Inclusion" is the slogan that captures the world-wide effort to make the web a valuable resource for all seven billion humans, "whatever of their abilities, age, economic situation, education, geographic location, language etc." (WWW's Web Accessibility Initiative). Indian rural contexts are the new horizon of internet accessibility. We suggest that they are best served bt open, collaborative web practices.

In this paper, we introduce the idea of re-narration as the basis for "designing for inclusion." In the re-narration model, a web page or even an element of a web is rewritten, i.e., /re-narrated/, to make it accessible to a target audience of users in a completely decentralized way. The notion of re-narration is completely general. It could, for example, mean translating a page automatically to another language. Or it could mean creating a more accessible version of a technical document, even if it is in the same language by an expert for laymen.

After motivating re-narration through a series of accessibility related examples, we present a simple formalisation of re-narration as a transformation on web elements. Using this formalization, we indicate how re-narration is a way of realizing the social semantic web. Finally, we present an implementation for re-narration.

Categories and Subject Descriptors

H.4.2 [Computers and Society]: Social Issues, Assistive technologies for persons with disabilities—*non-literacy*; H.5.3 [Information Interfaces and Presentation]: Group and Organization Interfaces—*Collaborative computing, Computersupported cooperative work*

General Terms

Human Factors, Languages

Keywords

Accessibility, Inclusion, Collaborative narration, Localization, Social Semantic Web

1. INTRODUCTION

The Web has been remarkable in making a great collection of diverse content available at our fingertips. Recent access to low-cost tablets and smart phones crosses many socioeconomic barriers, which presents very interesting opportunities and challenges.

Among the challenges is making content delivered to such devices truly accessible. It is one thing for content to be delivered to a device; it is another thing for that content to be productively consumable by the observer of that device. Services for rural users have commonly been provided via computer kiosks placed at a village office. Kiosks typically dispense information such as land records or tax information as part of an e-governance service. While this method can effectively transmit government experts and regulations to rural users, it is a one-way flow of official information. We envision the Internet as allowing more expansive, multiple-user experiences. A government document such as the Miminum Wage Act, for instance, is most useful to a non-expert user when it can be accessed along with discussions, debates, translations, and other re-narrations. In fact, bloggers often perform such services, by writing blogs based on something(s) they read on the Web. We propose a structured manner of accessing re-narrations, where the relationship between the source and target are preserved. This involves the design of web framework, filters, and server-supported browser extensions that can enable and enhance localised re-narration of Internet content.

Re-narration activity can be compared to various real-world frameworks that we have been using for centuries. News papers is a good example where people subscribe to a set of narrations that are more suitable for their orientation. An act that is passed in the government is hardly ever directly accessed by people. Various agencies will help narrate it to their subscribers. Then the local news papers will renarrate to their specific community interest and context. A analog for this on the Web can develop using the idea of renarration where the same url that is passed around renders the page content that is most suitable for the user (person who is browsing the page at that url) profile, possibly through subscription to re-narrator listing services. The activity of Web-accessibility [23] provides guidelines for authoring web pages so that tools can be used to assist a disabled person also access the page, say when a visually impaired person accesses the page using a text-to-speech tool. However, the re-narration activity subsumes the tool aided activity by including a group of narrators who are interested in the community. The *Alipi* framework further develops into a semantic web model that also exploits the social networks of interest into enabling e-inclusion through a mashup of suitable narratives for a target user - including addressing language barriors amoung the literate.

The major aims of this work are to:

1. Understand the scope, extent and well formedness of Web content re-narration and dynamic rendition based on user profile of the visitor. Is replacement at the level of HTML ids and xpaths the most appropriate unit of re-narration? What should be the name-space management with respect to the new ids that seep-in into the source page?

2. Provide an open source Web 2.0 development platform for authoring narratives and re-rendition as a browser extension. [12]

3. Develop a specification that helps address the various Web data types, that can be used by standards committees, while providing guidelines for paragraphs, videos (subtitles part), images, paragraphs to audio for now.

4. Demonstrate the Web framework model in various contexts such as the delivery of a governments' policy document for its citizens in a country like India.

2. **RE-NARRATION**

In order to introduce the idea of re-narration, let's take an example. Consider a web page, say of fire safety, which is originally authored in English as shown below.



Now imagine this link is sent to a person who does not read English but can read Hindi. The reader then asks if there is a Hindi narration of this page. And Web responds by looking for available Hindi narrations out there in various blog posts and renders the page using these. Say it can look like:



Notice that a search for alternative narratives that are suit-

able for the Hindi speaker (from India) has found an image of an Indian fire engine and also found a Hindi narrative for the second paragraph and re-rendered the page by substituting the alternative narratives that are more suitable for the Hindi speaker.

Similarly a Turkish or a French person could ask for rerendering of the page and see parts of the age or the whole page - depending on the contributed Turkish or French narratives out there on the Internet.

As we noticed in the page rendition for the Hindi reader, only part of the original page was re-narrated to a Hindi context. This means that alternative narrations were contributed for only parts of the original page. As Hindi rendition above shows, alternative narratives can be contributed to parts of a page by narrators who have an interest in narrations for a certain user group.

Technically, this is achieved by annotating a blog post as an alternative narration of a particular page of a source page. For example, a11y.in/a11ypi/idea/firesafety.html is the source page shown above. As explained in the idea page a11y.in/a11ypi/idea, a blog post that is meant to be an alternative narrative saves as meta information a reference to the part of the source page that is the source for the alternative narrative. In the Hindi blog case the meta information was part of the paragraph tag in the blog and has the attributes foruri and rec:

<p id="hi"

foruri="http://www.a11y.in/a11ypi/idea/firesafety.html:div1"

rec="lang:hi">

आग विभाग या आगशमक दल एक सार्वजनिक या निजी समस्था है जो

आग से होने वाली दुर्घटनाओं से सुरक्षा प्रधान करती है, जो आम तौर पे एक नगर -

पालिका या जिल्ला का निरिक्षण् करती है | एक विभाग के सिमा में आम तौर पे एक से

अधिक् आग शमक् स्टेशन् होते हैं | इन् सटेशनो मे व्याव्सयिक आग शमक या स्वयंसेवक

कार्य करते है |

This information is analogous to back-links in blogs. However, the semantics attributed in this case is that the text in Hindi is an alternative narrative for the text at 'id' div1 in the source page http://www.a11y.in/a11ypi/idea/firesafety.html and the 'rec' attribute indicates that this narrative is recommended for Hindi speaking contexts.

Audio narratives can also be blogged in a similar way. These narratives will trigger an audio player when a user mouses over a paragraph that has an alternative narrative recommended for the viewer's context.

2.1 Mediated Filter Services

Filters are a way for a web page to declare certain re-narrators as authorized or recommended or favorites. A filter is an XML file that lists URLs for re-narrators along with metadata about each URL (the re-narrator's identification, active subject categories, relative ranking, or FoaF details) so that one can declare a set of "favorite" re-narrators. End users can opt to subscribe to these filters by configuring the *alipi* profile on their browsers. [18]

Following is an example of a filter.

subsectionWeb Accessibility

Accessibility guidelines for the print-impaired.

The W3C WAI recommendations discuss accessibility issues and address them by providing accessible design solutions such as a text equivalent for images and other multimedia content to make it accessible for visually-impaired users; or a non-text equivalent for text targeting a deaf audience for instance. However, Alipi adds a different layer of design considerations to accessibility and literacy discussions.

Print-impaired users are people able to use their vision and their hearing capabilities, but have difficulties accessing written text. A non-disabled user navigates within the web page and understands its structure instantly by relying on image connotations or paragraph titles for example. It is, however, frustrating for a print-impaired user to use assistive technologies such as content readers in order to understand the page structure: using an auditory description is not adapted to their needs since they can see and would rather rely on their vision than their hearing. Another barrier is the language. In fact, if the spoken/written language is not familiar to the user, it would not help them understand what is going on.

Thus, the idea of Alipi accessibility guidelines is to allow a lay out, annotate, and otherwise enhance a web page's content in a certain way that allows print-impaired users to understand its structure by observing a network of connections between fragments of a page. [18]

Using these guidelines, the fire safety page can be rendered on a small screen of a mobile phone as:



Using the Alipi re-narrations, this could further render in a manner suitable to a user's *alipi* profile. For example, as:



Accessibility in general

Let G be a directed graph where the nodes are documents that exist on the web. There is an edge from d1 to d2 with a label L, if d2 is related to d1 in the sense described by label L. Strictly speaking, d2 and d1 could reference the same URI-accessible document, but d2 could be a transformation of d1. For example, d2 could be a re-rendering of d1 where d2 is WAI-accessible to someone with color-blindness, or d2 could be accessible to vision-impaired people.

WAI concerns itself with generating relatedness, not with identifying relatedness, i.e. the standard effectively makes it possible to generate d2 given d1. This kind of relatedness is primarily presentational (and thus, implicitly semantically related in a somewhat obvious way).

Alipi concerns itself with more generic semantic relatedness of documents, and also concerns itself with identifying relatedness as well as generating relatedness. i.e. given a document d1, it is interested in finding (either by identifying an existing one, or by generating one) a d2 that is related to d1 in the sense of L.

This is a really hard problem to solve efficiently for different notions of L-relatedness. Given a document d1, how will the set of L-related documents be discovered? Will they be generated (ex: machine translation across languages)? Or will they be fetched based on existing semantic markup on d1? Or, will they be fetched based on existing semantic markup on d2's? Or, will a document repository (e.g.: the web) be crawled to identify the set of L-related documents? If so, given a candidate document d2, what metrics will be used to determine if d1 and d2 are sufficiently closely L-related? Clearly, different domains and applications will require different standards of L-relationship between d1 and d2.

In light of the previous discussion, to avoid getting lost in an overgeneralized problem, Alipi focuses on a set of projects in specific sub-domains where L is well-defined, and specifies a set of attributes which enable the identification or generation of L-related documents.

Alipi is therefore a web-accessibility project with a difference: it allows users to re-narrate the Web, or to access others' re-narrations. Thus it changes access to web-content in ways that are relevant for any user, but may be particularly useful to print-impaired users and others who are lost in translation.

In order to address these issues, we formulate and propose a semantic social web [semsocwed]-like model that add a few tags to identify certain annotations as re-narrations, identify the target community for the re-narration and also identify the original object that is being renarrated using a combination of url and xpath. These web documents can then by indexed by services that aid the re-narration activities and the recommendation process to help choose the most suitable narration for an alipi user.

3. FORMALIZATION

We propose a series of simple syntactic models for understanding the structure of WWW. The goal of this modeling is to better understand the structure of WWW and their components using a simple framework. Using this framework, different webs are conceptualised, some of which illustrate certain interesting aspects of "the existing" WWW.

The type Web page is an element of the uninterpreted type \mathbf{W} . The lifted domain \mathbf{W}_{\perp} denotes the standard augmentation of \mathbf{W} by an "no information" page denoted \perp . Let \mathbf{U} denote Users who role is to consume web pages. The main idea in the model is that a web page is *interpreted* by a user, possibly as another web page. An *interpretation i by* a user of a web page is another web page. $i : \mathbf{U} \to \mathbf{W}_{\perp} \to \mathbf{W}_{\perp}$.

3.1 Examples

Identity interpretation. In the identity interpretation every page is interpreted to itself by every user. This is the web as we know it. As the examples below indicate, other interesting interpretations are possible,

3.1.1 Print Impairedness, re-narration and translation

Let $W : \mathbf{W}$ denote a set of web pages and $U : \mathbf{U}$ a set of users. Let L be a set of *languages* and let *lang* : $W \to L$ map a web page to the language that the node is written in. Let $n: U \to L$ denote the language that a user understands. (A more general treatment would allow n to map to a subset of L.) Then, the function $\pi : U \to W_{\perp} \to W_{\perp}$ where $\pi u w = w$ if lang(w) = n(u), and \perp otherwise is a model for *print impairedness* existing in the current web (which also assumes that literacy and competency levels of a user are identical to that of the author of the page).

To model how the problem of print impairedness can be alleviated, we consider a language-specific *re-narration* function $r: W \to L \to W$, where $r \ w \ l$ results in a page w' such that lang(w') = l. Re-narration provides an interpretation i of web pages via $r: i \ u \ w = r \ w \ n(u)$. We say a set of web pages is *print-inclusive* if there is an appropriate interpretation function on the set of pages such that $i \ u \ w$ results in a page that is in the native language of the user. The renarration may be realized using a translation function $\tau_{a,b}$ that translates pages from a language a to a language b so that $r \ w \ l = \tau_{lang(w),l} \ w$. Or it could be built by humans as part of the social semantic web, as explained in Section 2.

3.1.2 Spoken web for the visually impaired

Visually impaired humans require audio renditions of web pages to understand them. Assume that the set of web pages W is partitioned into three kinds, based on media: text W_t images W_i , and audio W_a :

$$W = W_t + W_i + W_a$$

Assume that the space of users is divided into those who are visually impaired (U_b) and those who are not (U_s) .

$$U = U_s + U_b$$

A *audio rendition* of a text node is a mapping $\rho : W_t \to W_a$. An interpretation $v : U \to W \to W$ of the WWW for the visually impaired is defined as follows:

$$v \ u \ w = \rho(w)$$
 if $u \in U_b$ and $w \in W_t$
 $= \bot$ if $u \in U_b$ and $w \in W_i$
 $= w$ otherwise

In the above example, we have assumed only a single language for web pages and their audio renditions. A useful extension of the model would associate a native tongue for each user and map audio renditions of pages into the visually impaired's native tongues.

3.2 Re-narration as term rewriting

In the previous subsection, we assumed that web pages are atomic entities, devoid of structure. We now consider web element \mathbf{W} as n-ary trees built from a set of *constructors C*. Example of constructors are a formalization of html elements like lists, tables, div's, etc. (We ignore other well-formedness conditions; admittedly our formalization is too liberal with the notion of what is a web page.) Given a web element, *subpages* of the element may be accessed in the standard way via *path expressions*. Each path expression is a sequence of branch indices, where each index identifies the position of an immediate sub-element of the parent element.

The true power of re-narration is realized when we consider re-narration of web elements rather than whole web pages. As a result, an interpretation of a page may be the result of a composition ("mashup") of the re-narrations of different elements of the page.

4. IMPLEMENTATION



Alipi web framework is supported by a set of tools that demonstrates the feasibility of the re-narration web. Alipi.us is a site that people can use to re-narrate and to also view available alternative narratives, with out having to install any browser extensions. These user utility tools are 1) authoring for narrators and 2) rendition of narrative for a target user.

4.1 The authoring-tool

The tool (see Figure 4.1) allows a user to re-narrate a web page of choice. It makes the page content (sub-trees/terms in a page) editable by giving the user the possibility to: replace a text content with text and/or provide an audio description of it, replace an image with another image more suitable for a given target - for example, cabs are yellow while in NYC but black in London, indicate the style of the re-narration - example: a summary, a translation...etc, indicate the language of the re-narration, indicate the geographical localization of the targeted community, enter tags - example: the name as the re-narration author, and post the narrative as a post in their own blog - which for now has to be a Blogspot blog.

4.2 The rendition tool

This tool allows a user to view a list of target for which alternative narratives are available, re-render the page using a selected mashup of available narratives for a target interest and further allows one to see available narratives (for terms/sub-trees/elements) at a xpath-indicated fragment of the page.

4.3 The server support

The posts concerning *alipi* narratives are indexed on an *alipi* server by crawling the content and the meta data in the tags of the posts in blogs. The server also responds by returning available narratives for a given url.

4.4 Plugin and mobile app

Alipi Firefox add-on helps in indicating to a user when alternative narratives are available for a url. In the future, this can be configured to indicate only if narratives are available that are suitable for the user. An Android browser app allows a mobile user to select a suitable narrative if available.

The initial version of *Alipi* browser extension is implemented as a Firefox plugin alipi.xpi [12].



This plugin supports notifying the user of available alternative narratives for a given url, re-rendition of the page using a set of narratives and authoring of re-narration of a web page. When a user opens a page she wants to re-narrate she clicks on the *Alipi* authoring tool as seen in Figure 4.4.

5. DISCUSSSION

5.1 Accessibility and the Print Impaired

There are several assistive technologies used for web browsing such as screen readers, speech recognition, screen magnification and keyboard overlays. Web-page authoring guidelines developed by the Web Accessibility Initiative (WAI) of the World Wide Web Consortium (W3C) that help in understanding and implementing web accessible content. However, these guidelines do not have a prescription for the print-impaired or to meet the needs of an 'oral web'. The issue of Web-accessibility for the print-impaired can be considered as the issue of the next-phase of Internet users - the next billion new users who may not be as literate as the earlier Internet users. This is large class of people who cannot read the content on Web-pages and will include billions of people who are illiterate but might soon find it easy to access the Web through their mobile phones. This is also an issue for inter-cultural inter-language inter-contextual communication that the current web is trying to cope with.

On the one hand, we need to look at how to author Webpages - the structure, appropriate tags and meta-tags, can help. On the other, we must inspect how Web X.0 can be utilized in making content accessible to a wider audience than what the original author could achieve. Such collaborative approaches are promising for making content creation feasible in terms of quantity (the number of re-narrations in various languages/audio/form) and quality (contextualization).

5.2 Oral culture versus the Internet

Web pages are text dominated. Web-accessibility has mostly been addressed in regions where illiteracy is not a major issue. As a result, the accessibility concerns have been focused on the physically disabled. However, in countries like India, many people are not comfortable with text, either because they are not literate, are partially literate, or because they are literate only in their localized language. Whatever the cause, many people are not able to consume provided content. More recently, there has been an influx of video content, which may be attributed to the availability mobile phones that make it easy to capture and post pictures and videos to various content sharing sites like YouTube.com. Given the explosion of collaborative technologies, the time is right for groups in South Asia (the nations and governments in the region, as well as service providers) to put the best technologies at the disposal of the bottom billion. It is especially important that such efforts employ collaborative design and use, rather than one-way models of information dissemination. Social science research as well as our own experience in rural development has show us that in many semi-literate contexts, information is collectively shaped and shared, and transmitted in multiple formats. We have termed these practices "re-narration", that is, the re-shaping of information for different contexts.

5.3 Non-formal Communications and community radio

There is a profound lack of appropriate and effective learning opportunities in remote, rural and resource-poor parts of the world. Schools, by and large, do not cater to informal or life-long learning needs of adults and youth. Universities and colleges have at best a limited footprint in rural and remote areas, where courses are rarely framed to meet the livelihood, health or development needs of communities or their members.

Just as it is hard to imagine universities offering informal educational services in developing areas, it is also unlikely that community groups could fill these gaps on their own. Services offered by local media, community development programs, information and communication technology (ICT) centers, developmental and other localized organizations are seldom effectively structured for engaged learning. There is, however, an untapped potential in the collaboration among educational institutions, local development agencies, media/ICT groups and communities, in combination with participatory platforms of Web X.0 and the unrealised possibilities of the semantic social web.

5.4 Alipi culture

Historically, web content has been predominantly textual. More recently, audio, video, and image based content is also commonly available. Community Radio promises to play a significant role for assisting in developing a culture of dialogue and sharing information localized to community needs. The penetration of smart phones into developing regions, and the recent launch of the \$35 "Aakash" tablet by the Indian government, have radically increased the reach of the Internet in developing regions. There are new challenges for designers and users to re-narrate web content in ways that increase sharing rather than shut down collaborative possibilities. One of the most interesting challenges, we suggest, is the possibility for collaborative re-narration of web content. We have proposed an approach whereby users can access as well as provide re-narrated content in a decentralised manner.

One use of Alipi might be to enable localization and contextualization of laws and policy documents that concern the citizens of a country, such as India, so that these documents become available on the mobile phones of the many print-impaired people. Towards this, we have authoring guidelines that document authors can use. Then the renarration model so an effective process can be initiated via the communities of interest or through those who have a mandate towards such activity. Filters help identify such communities of interest in certain context. For example, in the case of government documents that are put online, it may be natural for the authorities to announce the authorized re-narrators filter on their web-sites. This can become a directive to the Alipi's narration recommendation algorithm using which only the official translations or localization/contextualization are provided as choices to a user. See the page titled ReNarrationAct on alipi.janastu.org web-site to follow our case study of re-narrating a document regarding the law related to minimum wages and using an Android based phone to demonstrate that the print-impaired community of domestic workers can now "browse" this document using the Alipi toolbar on the Firefox browser.

This notion of Filters can also help bring to the Web, a parallel of print and news media organizations. For example, a bangalore.healthren.org can announce a Filter with list of favorites who they recommend as good re-narrators for health related web-pages for the locality of Bangalore, Karnataka. A user can subscribe to this Filter and choose the narratives from this list over others.

Eventually, it can remain as an end-user choice in spite of these suggested or authorized Filters as user can prefer the narrations from a list of friends over that of the authorized or that of the subscriptions, esp., in certain cases.

6. RELATED WORK

Various annotation mechanisms and frameworks have been in the works like Annotea [7]. The Social Semantic Web [6] is a new book that provides an overview of how interplay between semantic web and social networks are natural. Universal Subtitles [17] and TED open translation [19] are examples of community sourced re-narration for subtitling needs. Web Accessibility and Standards [14] [24] [21] [23] are defining the accessibility issues and guidelines for disabled users.

Stumpedia^[4] is website in which humans drive the activity of reviewing and ranking web pages and search results are based on personalization parameters. This approach is similar to re-narration in that both rely on user personalization, but different in that use the personalization information to do different things: in the re-narration web, the user chooses a re-narration, whereas in Stumpedia the personalization impacts the search results. Also, in Stumpedia, there is no notion of re-narration (as in page or element replacement).

Alipi related references are Alipi wiki [11], Alipi idea [8], a11y.in [9] and Alipi Report [18].

Aural style sheets [22], semantic tagging [20], Semantic Authoring By Tagging with Annotea Social Bookmarks and Topics [2], Internet Peer reviewed [13], Active Distributed Social Networks [15], HTML5 [3] and XPATH [1] are relevant to this work.

7. FUTURE WORK

There are many aspects of the proposed approach that need to be pursued. Re-narrations are done for a target community in mind. We are letting users indicate a target community using the attributes language, location and level. We now recognize that a user belongs to a target group by letting them choose a target manually. We are working on identifying targets and recommending the most suitable narrative using an ontology service to identify and match narrations to target users [5].

Assessing trust of content authors requires a trust model for contributors. When there are more than one re-narrations a choice of which one to render must be made. Such choices can be based on author rating or on what most users who identify with a target community choose. Another option is to present alternative views for which a ranking among choices is required. Again, rating or user choice is relevant for this purpose. For user preferences friendship networks based on like, follow or such relations could be utilized. Mapping such friendship networks based on narrators and users will lead to analysis of narrator blogs based on usage stats. For now, we are relaying on the *filters* to help deliver narratives that are recommended by communities. We consider this as the beginnings of user subscription to subject and location specific filter maintainers.

The plugin tool for re-narration is a proof of concept tool. The functionality and usability of the tool is being addressed with feedback from various groups of people. This is also being developed as an Android app and tested with mobile users including non-literate users.

Also more detailed examination of mobility as how it relates to content rendering is required. At present, the focus has been on content creation and its composition. Clearly, the composition must be suitable for the devices they are delivered on and the context of the viewer. For example, if they are in a state of movement – as often is the case – content must be organized in a manner appropriate for the attention span of someone in mobility. This might in various cases be quite useful for non-literate users.

8. CONCLUSIONS

We consider the accessibility of Web content to as many people as possible to be very significant. Automatic translation or systematic transformations by dedicated persons/machines not very feasible. This is especially true when contextualization comes into play. Fortunately, there are many Netizens who are very capable to perform these tasks. They can identify and articulate content in alternate in an appropriate manner – both in terms of meaning and in form. Socially networked uses of collaborative web design can lead to potentially infinite "re-narrations" of web resources. The new architecture we propose builds on rich ontological structures shared across social networks created in a distributed, decentralized manner, used with browser plug-ins and serversupported web applications. We build on recent advances in the architecture of Semantic Web; distributed active social networks [15] and Ontology servers [5]; browser based editors for re-narrations [16], HTML5, Web 2.0, browser extensibility, smart mobiles [10].

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